



Metabolic Health Status of Transition Cows in Dried up Cauvery Delta districts of Tamilnadu, India

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ABSTRACT

Transition cow health assessment study with 28 crossbreed Jersey and Holstein Friesian cows of 3 to 7-year-old were under taken. They were conventionally managed under field conditions over a period of 2 years. Two blood samples were collected from each cow and were assessed for haematological and biochemical analysis. There was significant variation ($p < 0.05$) found between MCH, MCHC and platelet values of pre and post partum cross bred cows. The erythrocyte count in pregnant cows was significantly higher than that of postpartum cows. In the present study, no significant differences were found between the prepartum and postpartum serum metabolites of globulin, phosphorus, total calcium and non-esterified fatty acids levels except for the concentrations of chloride and ionized calcium where the prepartum value was significantly ($P < 0.05$) higher than the postpartum values.

Keywords: Metabolic profile, Cross bred cows, Cauvery delta

Cauvery delta region was suffering from dried up rivers and drought. Farmers are looking for livestock as an alternative livelihood and predominantly depend on dairy cows for their daily living. Due to drought, feeds and fodders availability also dwindled and dairy animal health is ultimately affected. The transition period of cows from 3 weeks prior to 3 weeks after calving, is the most stressful (Grummer, 1995) and most cows encounter a state of negative energy balance, which leads to metabolic disorders and related complications and impaired fertility. In addition to negative energy balance, challenges like drought, non availability of feed, reduced feeding or imbalanced feeding further complicates metabolic issues. Several investigators have reported on the use of metabolic profiles to predict the occurrence of metabolic disease. Unfortunately the physiologic transition from a non-lactating pregnant state to a lactating state too often results in unwanted outcomes due to the cow experiencing one or more periparturient diseases (Goff and Horst, 1997). The economic losses due to poor peripartum management are

reflected in the suboptimal milk production, diminished reproductive performance, increased morbidity, mortality and high treatment cost. Therefore, periparturient management of cows in drought areas becomes a critical determinant of productivity and profitability of small holding dairy farmers. The metabolic profile was initially designed as a pre symptomatic diagnostic aid based on statistical analyses of blood metabolites to provide an early warning for certain types of metabolic disorders (Da *et al.*, 2015). Subsequently, metabolic profile has been applied to assess nutritional status, improve feeding management and diagnose metabolic disorders in dairy herds. The objective of the present study was to assess differences in body tissue mobilization during late pregnancy and early lactation, by comparing blood parameters between 3 weeks before parturition and 3 weeks after parturition as diagnostic tools of detrimental levels of blood metabolites and other electrolytes. The values obtained in this study were not associated with clinical disease. Therefore, these values represent baseline data considered compatible with

normal health during transition period in crossbred cows of Cauvery Delta districts of Tamil Nadu, India.

MATERIALS AND METHODS

Experimental design

Total 60 transition cows were assessed and out of which 24 were taken up for this study. The samplings were carried out during 2016-2018 over a period of 24 months from 28 crossbred Jersey and Holstein Friesian cows of 3 to 7 years old. They were conventionally managed transition cows under field conditions in small holder dairy units of Cauvery delta region. These animals were divided into two groups viz., Group 1 belongs to 3 weeks period before parturition and Group 2 belongs to 3 weeks period after calving. EDTA blood was used fresh on the day of collection while heparinized plasma and serum samples were centrifuged at 1500 rpm for 15 min at 15 °C and frozen in portions (-20 °C) until analysis. Faeces were examined for parasitic eggs by the sedimentation method. Thin blood films stained for differential blood counts were examined for blood protozoa. The blood samples were rejected in case of high parasitaemia. Red and white blood cell counts were determined in EDTA blood samples using automatic haematology analyser. The biochemical profiles included in this study were total protein, globulin, albumin, urea, creatinine, glucose, Non Esterified Fatty Acids, calcium, phosphorus, sodium, potassium and chloride.

All the biochemical profile were analyzed by semi-automatic biochemistry analyzer- bench-top SA-20 (Clindia Systems, Span Diagnostics Limited, India) using commercial kits except for NEFA, which was measured with the enzymatic colorimetric method (Randox Laboratories Ltd., Crumlin, UK). The prepartum and postpartum values were compared with standard reference values of healthy dairy animals.

Statistical analysis

The data obtained were analyzed using student's "t" tests (SPSS Inc., Chicago, IL, USA) and presented as Mean±SD. The mean differences between groups were considered significant if P<0.05.

RESULTS AND DISCUSSION

The crossbred cows may have different metabolic and electrolyte profiles from purebred and indigenous ones, and the changed management and feeding practices are known to affect serum biochemical parameters (Verheyen *et al.*, 2007). The values obtained in this study were not associated with clinical disease and represented the baseline data considered compatible with normal health during transition period in crossbred cows of Cauvery Delta districts of Tamilnadu, India. The mean haematological parameters of prepartum and postpartum dairy cows are presented in Table 1.

Table 1: Haematological parameters of transition cows

| Sl. No. | Parameters | Group I | Group II | p-Value |
|---------|-------------------------------------------------|-----------------------|-------------------------|---------|
| | | Prepartum cows (n=14) | Post partum cows (n=14) | |
| 1 | White Blood cells ($\times 10^3/\mu\text{l}$) | 10.09±3.25 | 11.54±5.81 | 0.422 |
| 2 | Lymphocytes ($\times 10^3/\mu\text{l}$) | 6.23±2.83 | 7.07±4.07 | 0.532 |
| 3 | Monocytes ($\times 10^3/\mu\text{l}$) | 0.52±0.38 | 0.72±0.62 | 0.313 |
| 4 | Neutrophils ($\times 10^3/\mu\text{l}$) | 3.20±2.77 | 3.43±3.08 | 0.837 |
| 5 | Eosinophils ($\times 10^3/\mu\text{l}$) | 0.57±0.53 | 0.45±0.57 | 0.569 |
| 6 | Basophils ($\times 10^3/\mu\text{l}$) | 0.07±0.06 | 0.15±0.23 | 0.219 |
| 7 | Lymphocyte (%) | 60.65±20.94 | 64.20±16.79 | 0.625 |
| 8 | Monocyte (%) | 4.69 ±4.16 | 6.41±3.54 | 0.249 |
| 9 | Neutrophil (%) | 29.22±22.80 | 25.15±19.90 | 0.619 |
| 10 | Eosinophil (%) | 4.10±2.22 | 2.72±2.02 | 0.097 |
| 11 | Basophil (%) | 0.70±0.51 | 0.88±0.49 | 0.350 |
| 12 | Red Blood Cell ($\times 10^6/\mu\text{l}$) | 5.19±1.57 | 4.14±1.62 | 0.093 |
| 13 | Hemoglobin (g/dl) | 8.74±2.86 | 9.90±1.93 | 0.220 |
| 14 | Hematocrit (%) | 25.38±8.61 | 23.13±6.37 | 0.439 |
| 15 | MCV (fl) | 45.93±4.78 | 45.43±4.22 | 0.772 |
| 16 | MCH (pg) | 17.45±3.69 | 26.94± 10.37 | 0.003* |
| 17 | MCHC (g/dl) | 38.01±8.60 | 58.79±20.60 | 0.002* |
| 18 | PLT ($\times 10^3/\mu\text{l}$) | 234.50±107.27 | 428.21±195.83 | 0.003* |

*indicates values were significant at p<0.05 level.

The hematocrit, red blood cells and eosinophils counts in prepartum cows was higher than postpartum cows. But these values were not significantly correlated each other. Whereas Nazif *et al.* (2008) found that the erythrocyte count in pregnant cows was significantly higher than the postpartum cows in 30 days after parturition. These changes in the hematological parameters were probably due to the pregnancy stress and glucocorticoid release from the adrenal gland (Nazif *et al.*, 2008). There was significant ($p < 0.05$) increase of MCH, MCHC and platelet values in post partum cross bred cows. High MCV and MCH and low MCHC in non-pregnant dry cows was previously reported (Kumar and Pachauri, 2000) and was comparable to our results.

The changes in the cell count of white blood line were well established in the pre partum and postpartum period and the results obtained were within physiological limits (Brun-Hansen *et al.*, 2006) except for eosinophils. High leukocytic count during different gestation stages was observed by Kumar and Pachauri (2000). No significant differences in leukocytes were observed in pre and post partum cows. The change was previously reported and may result from the stress (cortisol mediation) associated with parturition (El-Ghoul *et al.*, 2000 and Hadj *et al.*, 2015). Other typical reported changes of acute stress in cows like neutropenia or lymphopenia (Jain and Lasmanis 1978 and Barreiro *et al.*, 1987) were not observed in the present study. Meglia *et al.* (2005) documented a higher leukocytes count on the day of parturition than before and after calving. Quiroz-Rocha *et al.* (2009) reported no significant differences in the leukocytes count, except for eosinophils. This was similar to present study where in we observed of increased eosinophils counts of Prepartum cows than postpartum dairy animals. In the present study, the reasons for immune suppression in pregnant cows are not fully known, but several factors such as management, feeding and changes in hormonal levels may be involved. Suppression of leukocyte functions in dairy cows has been associated with negative energy balance around calving and in early lactation. Lymphocytes decreases around parturition (Saad *et al.*, 1989) mainly due to reduced lymphocyte proliferation. Discrepancies in values for various haematological parameters between our findings and previous studies may be explained by differences in sampling interval, used methods, numbers of cows sampled and/or degree of metabolic disturbances (Meglia

et al., 2005). Moreover, genetic differences between cows and environmental conditions might have a role for differences were sited (Mallard *et al.*, 1998) but not observed in this study. These data are also in concurrence with the previous reports in buffaloes where they did not found any differences in haematological profile during early and late lactation periods (Tambare, 2005 and Hagawane *et al.*, 2009). The mean prepartum and postpartum serum biochemical and electrolyte values of transition cows are shown in Table 2.

Table 2: Metabolic and electrolyte profile of transition cows.

| Attributes | Group I | Group II | t-value | p-value |
|----------------------|-----------------------|------------------------|---------|----------|
| | Prepartum Cows (n=14) | Postpartum Cows (n=14) | | |
| Glucose (mg/dl) | 60.93±5.7 | 54±10.4 | 2.18565 | 0.038* |
| Total protein (g/dl) | 9.27±1.09 | 8.14 ±0.8 | 3.1419 | 0.004* |
| Albumin (g/dl) | 3.39±0.4 | 2.71 ±0.3 | 5.03679 | 0.0003* |
| Globulin (g/dl) | 5.9±0.69 | 5.43 ±0.5 | 1.38212 | 0.179 |
| Phosphorus (mg/dl) | 7.55±2.06 | 6.25± 1.95 | 1.71113 | 0.098 |
| Calcium(mg/dl) | 10.83±2.09 | 9.84 ±0.59 | 1.71335 | 0.100 |
| NEFA (mmol/L) | 0.27±0.11 | 0.31±0.11 | -1.0772 | 0.291 |
| K (mmol/L) | 4.25±0.33 | 4.86±0.86 | -2.4647 | 0.020 |
| Na (mmol/L) | 131.53 ±3.63 | 131.4±3.71 | 0.09267 | 0.926 |
| Cl (mmol/L) | 103.07±1.38 | 98.68±2.76 | 5.31523 | 0.00015* |
| iCa (mmol/L) | 1.14±0.15 | 0.93±0.04 | 5.10193 | 0.0026* |
| nCa (mmol/L) | 0.79±0.1 | 0.91±0.11 | -2.9474 | 0.0066* |

*indicates values were significant at $p < 0.05$ level.

Assessing protein status is a bit more difficult than energy balance. At present there is no single metabolite that can be measured which directly reflects protein status. Significant differences were observed between pre and post partum total protein and albumin values. In our study, the total serum proteins levels were significantly affected and got reduced from the physiological period compared to late gestation. This was in disagreement with Piccione *et al.* (2012) who found increase of total serum protein during the lactation and a slight decrease during the dry period.

The variations reflect the maternal requirements of protein needs for milking and providing immunoglobulins. Glucose insufficiency in the transition period further results in low blood glucose after calving which induces body fat mobilization and transportation of nonesterified fatty acids (NEFA) to several organs, among them are the reproductive tissues and the liver.

In the present study, the concentration of glucose in blood was lowest on postpartum and this value was significantly lower ($P<0.05$) than the values confirmed in other time interval. Doepel *et al.*, (2002) reported that the concentration of glucose decreases in the first and second week of lactation and also a temporary fall in the level of blood glucose in the first weeks of lactation was observed to be the consequence of increased synthesis of lactose, and decreased gluconeogenesis. During peripartum period, hormonal changes primarily regulate parturition, initiate lactation and adapt metabolism (Adewuyiet *et al.*, 2005). These changes provoke hypoglycaemia postpartum (Ingvarsten, 2006), however, it is possible that some animals show gluconeogenic effect of adrenaline and cortisol due to stress induced by calving. To overcome the deficit of energy, body fat is mobilized resulting in an increase of NEFA concentration in blood. In the present study, no such significant differences were found between the prepartum and postpartum serum metabolites of globulin, phosphorus, total calcium and non-esterified fatty acids levels. Similarly to this study, Blum *et al.* (1983) reported that the postpartum concentration of NEFA increases significantly. Serum NEFA concentrations typically increase around parturition and are a major characteristic of the negative energy balance in the early postpartum. No significant variations were found between two groups in the serum potassium and sodium values, except for the concentrations of chloride and ionized calcium where the prepartum value was significantly ($P<0.05$) higher than the postpartum values. This was in disagreement with Iyorhemba *et al.* (2009) who observed significant differences ($p<0.05$) between the prepartum and postpartum values of serum sodium and phosphorus.

Serum calcium has been reported to show a tendency to decrease shortly after calving while plasma potassium levels increase in late prepartum and decrease in early postpartum (Belyea *et al.*, 1975). This was in agreement with our findings where we found significant variations between pre and post partum ionized calcium values. Low

blood phosphorus levels are commonly found in grazing cattle (Parker and Blowey, 1976), and therefore dietary supplement may be essential.

CONCLUSION

In draught affected animals, different reference limits for prepartum and postpartum dairy cows should be determined for biochemical analytes, in order to permit clinicians to make appropriate interpretation of the results. Particular attention should be paid to attributes of energy balance, fatty acids, and calcium, in which the determined limits for the weeks before and after calving are markedly different from those for peak- or mid-lactation reference limits. Hematological differences were not critical; peak- or mid-lactation reference limits are likely applicable to transition period cows. Marked biochemical changes were present around the transition period. Our findings may provide some basis for understanding the haematological and metabolic profile of cross bred transition cows in drought affected regions. Information provided in this paper, will help advance continuous investigations to promote animal welfare and can be a useful tool in managing and preventing the deficiencies typical of high production ruminants especially in drought region.

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